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VIII.—*Observations on the Coal Formation in Chile, S. America.*

By WILLIAM BOLLAERT, Esq., F.R.G.S.

*Read, June 11, 1855.*

SPANISH and some old foreign writers mention the existence of coal as occurring on the coast as well as in the interior of Chile. During the period of the Spanish occupation of the country, for all purposes in which fuel was required, wood or charcoal was resorted to. Since the great political changes and separation of the colonies from Spain, and their formation into independent governments, with the influx of foreigners with their trade and arts, Chile in particular has commenced being a manufacturing country; a very important branch is that of copper-smelting, in which the native coal is now being used; the steamers are supplied with it, also iron and other foundries, and it is used for domestic purposes and exportation.

As various opinions have been expressed as to the character of Chile coal, I propose in the following remarks to consider the subject in its several bearings.

In 1825-7, whilst residing in Peru, I saw the Talcahuano coal used in the forge; it was very light, friable, sulphurous, but slightly bituminous, and so inferior that it was thrown aside:\* it was more of a lignite than coal, and little hope was then entertained that a useful article could be extracted from the coal beds of Talcahuano or its vicinity.

In 1828, in company with Mr. George Smith of Iquique, in a survey of the island Quiriquina, in the bay of Concepcion, we found indications of carbonaceous matter, such as was met with at Talcahuano, also at Lirquen in the same bay; but from its peculiar character, and the soft sandstones accompanying it, our impression was, that we could only refer it to a lignite formation, or at most to that of a very imperfect coal, and it did not appear to us that by following the seam, an article of much better quality would be obtained.† Darwin, who visited Chile 1832-36, is the first who has given us any idea of the geology of the country, and when adverting to that of the coast, indicates granites, schists, sandstones, lignite, &c., and imperfect coals, and states that the coal-formation from Chiloe to Concepcion is a very ancient tertiary one. The fact, however, of there being imperfect coal in the country, caused the mines of Talcahuano and Lirquen to be worked, and search to be made in a southern direction, when the bay of Coronel was examined;‡ and as coal was then particularly

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\* Surface and weatherworn coal.

† So thought Darwin in 1835.

‡ Coal was found here and mentioned by Capt. Fitz-Roy in 1835. See *Voyages, Adventures, &c., of Beagle*, vol. ii.

required for copper-smelting, it was found there of a better quality and in abundance, and the neighbouring district of Lota was also discovered to contain coal.

In the year 1840 the coal of the Morro Hill\* at Talcahuano was examined by Mr. Wheelwright and Mr. Peacock, the superintendents of the Pacific Steam Navigation Company; and after several trials had been made with specimens from this spot under the boilers of the steamer 'Peru,' it was found to give abundance of steam, although yielding a large amount of residuum, and about 20 per cent. greater consumption than the best Welsh coals, requiring consequently more space in the ship and greater labour in working. These gentlemen, however, being thrown upon their own resources by the non-arrival of coal from England, continued their researches, and commenced the working of the mines in earnest, by driving levels and sinking pits in the hill of the Morro, and actually worked out 30,000 tons, which was all burnt on board the steamers 'Peru' and 'Chile' during their voyages up and down the coast. Mr. Peacock, with the aid of a ship's blacksmith, managed to construct a boring-rod, and by boring in the plain at the back of the Morro, he discovered a seam of superior coal at the depth of 130 feet below the level of the sea, where he sunk a pit 9 feet in diameter, bringing up the water by means of a jack-roll and buckets; but in the absence of a pumping-engine (not to be obtained on the coast at that time) it gained on the sinkers just as the seam was won, and the pit was filled with water.

About this time large shipments of guano were being made from Peru, and the freight of English coal being reduced to 20s. per ton, it was found cheaper to use English coal, and the works were not prosecuted. The increase of steamers on the coast for the last three years caused a larger demand, and the seam at Lota was at once opened, and is now being worked to a great extent: it was worked, as was Coronel, by means of levels, but which method is now being abandoned, particularly at Lota, for that of working by pits. Some two years since the Lota Coal Company was established, and the operations are now carried on under the management of M. B. Whyte, Esq., according to the English mode of working, but steam-engines will shortly supersede the use of oxen at the whims; and as the requirements of coal are rapidly increasing, Lota — not long since part of the wilderness road to Arauco — will be a flourishing locality.

My own impression in regard to Chile coal, when previously in the country, was, that it was a lignite, or at most, a very imperfect coal; however, on arriving at Iquique, in Peru, 1854, and examining the fuel from Coronel and Lota, and seeing it used with ad-

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\* Lord Cochrane, Captain Basil Hall, and others used the Concepcion coal.

vantage at the nitrate of soda refineries of Tarapaca, I was obliged to confess that there was a coal-formation in Chile.

Having occasion to go to Valparaiso on the 3rd of June, I took passage in the steamer 'New Granada,' on board of which vessel I had the opportunity of observing the practical application of Lota coal to steaming purposes. The chief engineer, Mr. Henderson, informed me that it was now more than twelve months since he had used this coal: the first two voyages the ship was deficient in steam, on account of their not being acquainted with the burning of the coal, and furnaces not being properly adapted to its use; but a little alteration being made in them, by giving more air and less draught, there has not been the slightest difficulty in using Lota coal, and that the difference of consumption is somewhat more than good Welsh coal. The engineer stated that it is said to be liable to spontaneous combustion, but that in his experience he has not seen the slightest tendency to do so.

The following embraces a most important item regarding this coal in a pecuniary point of view:—

The 'New Granada' consumed 15 tons Welsh coal per day, value 18 dolls. per ton, equal to 270 dolls. per day; this same steamer consumes 18 tons of Lota coal at 6 dolls. per ton, which is a saving of 18,360 dolls. per annum, or 3,670*l*.

From a communication written on board the steamer 'Yapkee Blade,' between Valparaiso and Panamá, dated April 12th, 1854, the following is extracted:—

"The quality of the Lota coal is excellent, and superior to that hitherto found in Chile; it is a rich bituminous article. As to the facilities of loading, the 'Yankee Blade' took in 700 tons in 3 days. Lota is a port of entry, allowing vessels in ballast to enter there direct from foreign ports. The steamer 'America' made, with Lota coal, her voyage from Valparaiso to Panamá in less than 10 days; the last 24 hours the 'Yankee Blade' ran 277 miles, and the difference between the Lota and Cardiff coal was only 5 per cent. in favour of Cardiff."

I landed at Lota the 6th of June (Lutrin Point, lat. 37° 4' 10" S., long. 73° 16' 5" W.). The port is good, and protected from "Northerners." There was great activity observed in raising the coal from the pits; it is screened at the pit mouth, bagged and weighed, carted to the beach, put into launches, and by these taken on board. The present settlement is along the summit of the hills, containing a population of more than 600 labourers, some being Scotch coal miners. I examined the surface of the country, which is undulating land and ravines; on the sea-shore are observed indurated sandstones and conglomerates, and in places the coal seams cropping out. The geological formation is, as Darwin states, an old tertiary; continuing easterly the

valley of Lota is attained, and the coal-formation appears to extend some little distance inland, where it is seen to rest on schistose rocks of the Colcura range. There are deep valleys farther to the E., and I was informed that the sandstone formation of the coast is there also; a rich vegetable mould covers the face of the country; pastures are in abundance as well as timber, and the climate is most healthy. I visited the neighbouring district of Coronel, where there are levels and pits some 30 in number. I descended the Lota pit, passing various seams of sandstones, clay, fire-clay, and at 40 yards came to the working coal seam. The declination of the strata is about 1 in 10 to W.N.W.; the coal seam a little more than 4 feet thick. It looked well developed, comparatively hard, and generally clean. In some positions there are troubles and up and down throws, but no fire or choke damp. The largest section of this coal-field is from the No. 5 boring in Lottilla valley. It is one of 80 yards 11 inches, composed of 35 different layers from surface, the 16th being the first coal seam of 4 feet 1 inch; the 34th layer is the second coal seam of same thickness as the first. This carbonaceous deposit has been described by practical persons as a good bituminous coal, in which I entirely concur; and I have been somewhat tardy in coming to this conclusion, on account of the impression the lignitiferous coal of Talcahuano made upon me in former times.

The Admiralty Investigation Committee gives the following analyses of the lignite of Talcahuano:—ash 6·92, carbon 70·71, hydrogen 6·44, oxygen, sulphur, nitrogen 16·93 = 100. Dr. Playfair's analysis of Colcura coal, identical with the outcrop at Lota:—ash 5·68, carbon 78·30, hydrogen 5·30, oxygen 8·37, sulphur 1·06, nitrogen 1·09 = 100. Mr. Abel of Coquimbo gives the following recent analysis of Lota first seam:—ash 2·05, carbon 83·70, hydrogen 1·02, oxygen and nitrogen 13·23 = 100, and he remarks that the Lota coal is equal in quality to many of the best English coals. Its specific gravity is 1·300.

It has been shown that this old tertiary formation is of great extent, particularly along the coast. Coal has been found in the Straits of Magellan, and indications of it only 30 miles S. of Valparaiso, and there is reason to believe that coal may be met with to the E. of the coast ranges in the south.

The Lota coal district is estimated to contain about 40 million tons of coals; Coronel, double that quantity. The shaly strata above and below the coal, contain impressions in abundance of a large leafy plant, bunches of stuff like burnt straw, and indications of calamites and pines.

*Valparaiso, 28th June, 1854.*

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